

What is claimed is:

1. A lighting apparatus for emitting white light comprising:
a semiconductor light source emitting radiation having a wavelength in the range of from about 250 to about 550 nm;
a phosphor composition radiationally coupled to the semiconductor light source, the phosphor composition comprising a blue emitting phosphor, a red emitting phosphor and a green emitting phosphor comprising $Na_2(Ln_{1-y-z}Ce_yTb_z)_2B_2O_7$, wherein Ln is selected from the group consisting of La, Y, Gd, Lu, Sc and combinations thereof and wherein $y = 0.01-0.3$ and $z = 0.01-0.3$.
2. The lighting apparatus of claim 1, wherein the semiconductor light source is a light emitting diode (LED).
3. The lighting apparatus of claim 2, wherein the LED comprises a nitride compound semiconductor represented by the formula $In_iGa_jAl_kN$, where $0 \leq i; 0 \leq j, 0 \leq K$, and $i + j + k = 1$.
4. The lighting apparatus of claim 1, wherein the phosphor composition is coated on the surface of the semiconductor light source.
5. The lighting apparatus of claim 1, further comprising an encapsulant surrounding the semiconductor light source and the phosphor composition.
6. The lighting apparatus of claim 1, wherein the phosphor composition is dispersed in the encapsulant.
7. The lighting apparatus of claim 1, further comprising a reflector cup.
8. The lighting apparatus of claim 1, wherein the green emitting phosphor comprises $Na_2(Gd_{0.85}Ce_{0.05}Tb_{0.10})_2B_2O_7$.

9. The lighting apparatus of claim 1, wherein said phosphor composition further comprises at least one of a blue-green emitting phosphor, an yellow-orange emitting phosphor, an orange emitting phosphor and a deep red emitting phosphor.

10. The lighting apparatus of claim 9, wherein said phosphor composition comprises a spectral weight of 0.0-0.4 of the blue phosphor, about 0.05-0.6 of the $\text{Na}_2(\text{Ln}_{1-y-z}\text{Ce}_y\text{Tb}_z)_2\text{B}_2\text{O}_7$ phosphor, about 0.05-0.55 of the red phosphor, and about 0.0-0.75 of the yellow-orange phosphor.

11. The lighting apparatus of claim 1, wherein the green emitting phosphor comprises $\text{Na}_2(\text{Ln}_{1-y}\text{Ce}_y)_2\text{B}_2\text{O}_7$, wherein Ln is selected from the group consisting of La, Y, Gd, Lu, Sc and combinations thereof and wherein $y = 0.01-0.3$.

12. The lighting apparatus of claim 1, wherein said blue emitting phosphor is selected from the group consisting of $(\text{Ba},\text{Sr},\text{Ca})_5(\text{PO}_4)_3(\text{Cl},\text{F},\text{Br},\text{OH})$: Eu^{2+} , Mn^{2+} ; Sb^{3+} , $(\text{Ba},\text{Sr},\text{Ca})\text{MgAl}_{10}\text{O}_{17}$: Eu^{2+} ; $(\text{Ba},\text{Sr},\text{Ca})\text{BPO}_5$: Eu^{2+} ; $(\text{Sr},\text{Ca})_{10}(\text{PO}_4)_6$ * $n\text{B}_2\text{O}_3$: Eu^{2+} ; $2\text{SrO} * 0.84\text{P}_2\text{O}_5 * 0.16\text{B}_2\text{O}_3$: Eu^{2+} ; $\text{Sr}_2\text{Si}_3\text{O}_{8+2}\text{SrCl}_2$: Eu^{2+} ; $\text{Ba}_3\text{MgSi}_2\text{O}_8$: Eu^{2+} ; $\text{Sr}_4\text{Al}_{14}\text{O}_{25}$: Eu^{2+} ; and $\text{BaAl}_8\text{O}_{13}$: Eu^{2+} .

13. The lighting apparatus of claim 1, wherein said red phosphor is selected from the group consisting of $(\text{Gd},\text{Y},\text{Lu},\text{La})_2\text{O}_3$: $\text{Eu}^{3+},\text{Bi}^{3+}$; $(\text{Gd},\text{Y},\text{Lu},\text{La})_2\text{O}_2\text{S}$: $\text{Eu}^{3+},\text{Bi}^{3+}$; $(\text{Gd},\text{Y},\text{Lu},\text{La})\text{VO}_4$: $\text{Eu}^{3+},\text{Bi}^{3+}$; $(\text{Ca},\text{Sr})\text{S}$: Eu^{2+} ; SrY_2S_4 : Eu^{2+} ; CaLa_2S_4 : Ce^{3+} ; $(\text{Ca},\text{Sr})\text{S}$: Eu^{2+} ; $3.5\text{MgO} * 0.5\text{MgF}_2 * \text{GeO}_2$: Mn^{4+} (MFG); $(\text{Ba},\text{Sr},\text{Ca})\text{MgP}_2\text{O}_7$: $\text{Eu}^{2+},\text{Mn}^{2+}$; $(\text{Y},\text{Lu})_2\text{WO}_6$: $\text{Eu}^{3+},\text{Mo}^{6+}$; $(\text{Sr},\text{Ca},\text{Ba})_3\text{MgSi}_2\text{O}_8$: $\text{Eu}^{2+},\text{Mn}^{2+}$; and $(\text{Ba},\text{Sr},\text{Ca})_2\text{SiO}_4$: Eu^{2+} .

14. The lighting apparatus of claim 1, wherein the semiconductor light source emits radiation having a wavelength of from 370-500 nm.

15. The lighting apparatus of claim 14, wherein the semiconductor light source emits radiation having a wavelength of from 400-410 nm.

16. A composition of matter having the formula $Na_2(Ln_{1-y-z}Ce_yTb_z)_2B_2O_7$, wherein Ln is selected from the group consisting of La, Y, Gd, Lu, Sc and combinations thereof and wherein $y = 0.01-0.3$ and $z = 0.0-0.3$.

17. The composition according to claim 16, wherein said composition is capable of emitting light having a peak emission at about 545 nm when excited with light having a wavelength of 405 nm.

18. The composition according to claim 16, wherein the composition has the formula $Na_2(Gd_{0.85}Ce_{0.05}Tb_{0.10})_2B_2O_7$.

19. The composition according to claim 16, wherein said composition is suitable for use as a phosphor for converting UV light to visible green light in an UV LED lighting system.

20. The composition according to claim 16, wherein said composition is suitable for use as a green emitting component of a phosphor blend for use in an LCD backlight.

21. A method for forming a lighting apparatus, the method comprising the steps of:

providing an LED capable of emitting radiation having a wavelength of about 250-550 nm;

radiationally coupling a phosphor composition to the LED, the phosphor composition comprising a blue emitting phosphor, a red emitting phosphor and a green emitting phosphor comprising $Na_2(Ln_{1-y-z}Ce_yTb_z)_2B_2O_7$, wherein Ln is selected from the group consisting of La, Y, Gd, Lu, Sc and combinations thereof and wherein $y = 0.01-0.3$ and $z = 0.0-0.3$;

wherein the phosphor composition is capable of absorbing

the radiation emitted by the semiconductor light source and converting the radiation into white light.

22. The method according to claim 21, wherein the step of providing an LED is performed by providing a UV/blue LED having an emission wavelength of from 370-500 nm.

23. A phosphor blend comprising a blue emitting phosphor, a red emitting phosphor and a green emitting phosphor comprising $\text{Na}_2(\text{Ln}_{1-y-z}\text{Ce}_y\text{Tb}_z)_2\text{B}_2\text{O}_7$, wherein Ln is selected from the group consisting of La, Y, Gd, Lu, Sc and combinations thereof and wherein $y = 0.01-0.3$ and $z = 0.0-0.3$.

24. The phosphor blend of claim 23, wherein said phosphor blend is capable of absorbing the radiation emitted by a semiconductor light source emitting from 370-500 nm and converting the radiation into white light.